

O P E R A T I N G   A N D   S E R V I C E   M A N U A L

**HP 8494A/B  
HP 8495A/B  
HP 8496A/B  
ATTENUATORS**



HP Part No. 08494-90008  
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## GENERAL INFORMATION

This manual contains operating instructions including installation and test information for the HP 8494A/B, HP 8495A/B, and HP 8496A/B Step Attenuators.

On the rear cover of this manual, below the manual part number, is a microfiche part number. This number may be used to order a 100 x 150 mm (4"x 6") microfilm transparency of the manual. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

### Specification

Instrument specifications are listed in Table 1. These specifications are the performance standards or limits against which the instruments may be tested.

### Instruments Covered by Manual

The instruments covered by this manual have a two-part serial number. The first four digits and letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply to instruments with serial prefixes 2544A and above.

Older instruments, those with serial number prefixes of 2543A and below, are documented in this manual under **MANUAL CHANGES** on page 7.

An instrument manufactured after the printing of this manual may have a serial prefix that is not listed above. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a Manual Change supplement containing change information that documents the differences.

### Description

HP 8494A/B, HP 8495A/B, and HP 8496A/B are 50-ohm coaxial Step Attenuators. The attenuation can be varied in 1 dB steps for the HP 8494A/B or 10 dB steps for the HP 8495A/B or HP 8496A/B by rotating the knob. The attenuation shown on the control knob is the additional attenuation added in

the signal path over the insertion loss of the attenuator in the 0 dB position. Accuracy is within the limits given in Table 1. The HP 8494A/B are four-section attenuators ranging from 0 dB to 11 dB in 1 dB steps. The HP 8495A/B are three-section attenuators with a range of 0 dB to 70 dB in 10 dB steps while the HP 8496A/B units range from 0 dB to 110 dB in 10 dB steps.

The attenuator sections are connected in cascade. Each section consists of a precision, thin-film attenuator card, a lossless thru-line, and a ganged pair of edge line transmission lines. The edge lines are flexed to make contact with either the attenuator card or the thru-line. The edge line contacts are gold-plated leaf springs which ensure long life and high repeatability. Low-torque cams flex the edge lines. Table 2 shows the switching arrangements.

### Warranty

Attenuators are warranted only when they are operated within their specifications, especially power handling capability. Any attenuators returned to Hewlett-Packard under warranty will be examined carefully to determine if failure was due to improper use. Be sure to observe the following cautions.

### CAUTION

*Do not exceed the RF power rating of 1W average, or 100W peak with a maximum pulse width of 10 µs. Do not connect an attenuator RF input or output connector to greater than ±7 Vdc. If the attenuator must be connected to a device with a potential greater than ±7 Vdc, use a blocking capacitor.*

### Options

Each instrument is specified with an option number which denotes the input and output connectors' configuration. The options are as follows:

- 001: Both connectors Type N female jack
- 002: Both connectors SMA female jack
- 003: Both connectors APC-7.

## INSTALLATION

### Initial Inspection

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and

Table 1. Specifications

**FREQUENCY RANGE:**

8494A, 8495A, and 8496A: DC to 4 GHz

8494B, 8495B, and 8496B: DC to 18 GHz

**ATTENUATION:**

8494A and 8494B: 0 dB to 11 dB in 1 dB steps

8495A and 8495B: 0 dB to 70 dB in 10 dB steps

8496A and 8496B: 0 dB to 110 dB in 10 dB steps

		Attenuation Accuracy ( $\pm$ dB): (Referenced from 0 dB)								
8494A & B	8495A & B 8496A & B	8494A	8494B		8495A	8495B		8496A	8496B	
Attenuation Selection (dB)		DC-4 GHz	DC-12.4 GHz	12.4-18 GHz	DC-4 GHz	DC-12.4 GHz	12.4-18 GHz	DC-4 GHz	DC-12.4 GHz	12.4-18 GHz
1	10	0.2	0.3	0.7	0.2	0.5	0.6	0.2	0.5	0.6
2	20	0.2	0.3	0.7	0.4	0.7	0.8	0.4	0.7	0.8
3	30	0.3	0.4	0.7	0.5	0.9	1.2	0.5	0.9	1.2
4	40	0.3	0.4	0.7	0.7	1.2	1.6	0.7	1.2	1.6
5	50	0.3	0.5	0.7	0.8	1.5	2.0	0.8	1.5	2.0
6	60	0.3	0.5	0.8	1.0	1.8	2.4	1.0	1.8	2.4
7	70	0.4	0.6	0.8	1.2	2.1	2.8	1.2	2.1	2.8
8	80	0.4	0.6	0.8	—	—	—	1.3	2.4	3.2
9	90	0.4	0.6	0.8	—	—	—	1.5	2.7	3.6
10	100	0.4	0.6	0.9	—	—	—	1.6	3.0	4.0
11	110	0.5	0.7	0.9	—	—	—	1.8	3.3	4.4

**MAXIMUM SWR:**

8495A: DC to 4 GHz, 1.35

8495B: DC to 8 GHz, 1.35; 8 to 12.4 GHz, 1.5; 12.4 to 18 GHz, 1.7

8494A, 8496A: DC to 4 GHz, 1.5

8494B, 8496B: DC to 8 GHz, 1.5; 8 to 12.4 GHz, 1.6; 12.4 to 18 GHz, 1.9

**MAXIMUM RESIDUAL ATTENUATION:**

8494A and 8494B: 0.6 dB + 0.09 dB/GHz

8495A and 8495B: 0.4 dB + 0.07 dB/GHz

8496A and 8496B: 0.6 dB + 0.09 dB/GHz

**ATTENUATION REPEATABILITY:**

±0.01 dB typical after 5 million cycles

**ELECTRICAL****RF POWER HANDLING CAPABILITY:**

All models: 1 watt average, 100 watts peak with maximum pulse width of 10 microseconds.

**GENERAL****DIMENSIONS<sup>1,2</sup>:**

Models 8495A &amp; B

130 mm (5-1/8 in.) long

73 mm (2-7/8 in.) wide

43 mm (1-11/16 in.) high

Models 8494A &amp; B and 8496 A &amp; B:

159 mm (6-1/4 in.) long

73 mm (2-7/8 in.) wide

43 mm (1-11/16 in.) high

**MINIMUM LIFE:**

&gt;5 million cycles per section

**WEIGHT<sup>2</sup>:**

Models 8495A &amp; B:

Net 312g (11 oz.)

Models 8494A &amp; B and 8496A &amp; B:

Net 425g (15 oz.)

<sup>1</sup> Dimensions are for general information only. If dimensions are required for building special enclosures, contact your HP field engineer.<sup>2</sup> Weight and width of the instrument varies with the option selected due to the type of connectors.

**Table 2. Attenuator Switching Order**

8494A & B					8495A & B					8496A & B				
Attenuator Sections					Attenuator Sections					Attenuator Sections				
Atten dB	1	2	3	4	Atten dB	1	2	3	Atten dB	1	2	3	4	
	1 dB	2 dB	4 dB	4 dB		10 dB	20 dB	40 dB		10 dB	20 dB	40 dB	40 dB	
0					0				0					
1	X				10	X			10	X				
2		X			20		X		20		X			
3	X	X			30	X	X		30	X	X			
4			X		40			X	40					X
5	X				50	X			50	X				
6		X	X		60		X	X	60		X	X		
7	X	X	X		70	X	X	X	70	X	X	X		
8			X						80			X		X
9	X		X	X					90	X		X	X	
10		X	X	X					100		X	X	X	
11	X	X	X	X					110	X	X	X	X	

the instrument has been checked mechanically and electrically. A procedure for checking electrical performance is given under "Operator's Check" (also see PERFORMANCE TESTS). If the contents of the shipment are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

### Mating Connectors

Mating connectors used with the Option 001 must be Type-N male connectors which comply with U.S. military standard MIL-C-39012. For Option 002, male SMA connectors must be used. For Option 003, APC-7 mating connectors must be used.

### Operating Environment

The operating environment of the instruments should be within the following limits:

Temperature: 0 to +55°C  
 Humidity: <95% relative  
 Altitude: <4600 metres (15 000 feet).

### Installation Precaution

When installing the instrument, make sure that the connectors do not support weight or bear

torque. The preferred procedure is to set up all equipment in position before connecting the instrument. Either connector may be used as the input or output connector.

### Installation Instructions

The attenuators may be installed with or without the base. The base is removed by unscrewing the two fillister head screws from the bottom of the base. The attenuator may be mounted without the base by inserting two 4-40 screws into the screw holes in the bottom of the attenuator. Removing the base and mounting the attenuator does not affect the performance of the attenuator.

### Storage and Shipment

**Environment.** The instrument should be stored in a clean, dry environment. The following environmental limits apply to both storage and shipment:

Temperature: -40°C to +75°C  
 Humidity: <95% relative  
 Altitude: <7600 metres (25 000 feet).

**Original Packaging.** Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

## OPERATING INSTRUCTIONS

### CAUTION

*Do not apply power greater than 1 watt average, or 100 watts peak with a maximum pulse width of 10 microseconds. If these limits are exceeded, the Attenuators may be damaged.*

After the instrument is connected, the attenuation may be selected. Turn counterclockwise to increase attenuation or clockwise to decrease attenuation. Either connector may be used as the input or output.

### CAUTION

*Do not attempt to force the switch between 0 and the highest value position as there is a stop between these switch positions.*

## OPERATOR'S CHECK

The Operator's Check (Figure 1) is supplied to allow the operator to make a quick check of the instrument prior to use or if a failure is suspected.

## PERFORMANCE TESTS

The instrument can be tested to the accuracy of the specifications in Table 1 with an Automatic Network Analyzer or equivalent equipment of suitable accuracy. If an Automatic Network Analyzer is available, test the instrument using the procedures in the analyzer's operating manual.

## ADJUSTMENTS

This instrument has no adjustments, and should not be opened. If defective, return the instrument to the nearest Hewlett-Packard office for repair.

## REPLACEABLE PARTS

### CAUTION

*Due to special fixtures necessary for assembly, do NOT attempt to replace any parts not listed in Table 3. If the instrument is opened, the warranty is void.*

Table 3 lists the replaceable parts which are the only parts that can be replaced without access to the interior of the instrument.

If any parts not listed in Table 3 need replacement, return the instrument to Hewlett-Packard.

To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

## SERVICE

### Troubleshooting

Troubleshooting consists of performing the Operator's Check shown in Figure 1. If the instrument does not perform within limits, return the instrument to Hewlett-Packard.

### Repair

The only recommended field repair is replacing the outer connector shell for the Option 001 and 003, or replacing the center contact in the APC-7 connector. For any other repair, return the entire instrument to Hewlett-Packard.

### Replacing the APC-7 Connector Center Conductor Contact

Through wear or damage, the contact in the APC-7 center conductor may need replacement. This contact is a small four-pronged contact which snaps into a recess in the center conductor. With a magnifying glass, examine the contact for the necessary outward spring action by carefully pushing it in. DO NOT REMOVE THIS CONTACT FOR INSPECTION. (It may be damaged by removal.) The prongs of the contact should be free from burrs or wear. If the contact is removed, DO NOT reuse it. Order contact as Amphenol Part Number 131-129 or HP Part Number 1250-0907. If this contact needs replacement, proceed as follows:

- a. Place the instrument so the connector faces down.
- b. Tap the connector lightly and the contact should now protrude slightly. Insert the centering pin of the HP Contact Extractor, Part No. 5060-0236, with the jaws open.
- c. Allow the jaws of the tool used to close and pull straight back from the connector without twisting.
- d. Snap in a new contact by pushing it in place. Test the action of the new contact by pushing it in. It should spring out again when released.

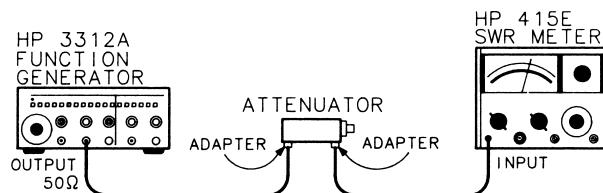
## OPERATOR'S CHECK

### DESCRIPTION:

The attenuator is driven from a 50-ohm signal source at 1 kHz. The output level from the attenuator is detected by a narrow-bandwidth voltmeter. The attenuator and detector range switches are stepped together and the variations in level noted. This verifies that each attenuator section is being properly switched and checks the low-frequency accuracy of the attenuator.

### NOTE

*The SWR meter used in this check is calibrated for a square-law detector and therefore the range changes and errors (read in dB) are twice that indicated by the meter.*



### PROCEDURE:

1. Connect equipment as shown above with attenuator set to 0 dB.
2. Set test oscillator to 0.3 Vrms at 1 kHz.
3. Set SWR meter range to 2 dB (expanded) [or for the 8494A & B to 10 dB (expanded)] and adjust its bandwidth to center of adjustment range. Fine tune oscillator frequency to obtain maximum meter indication.
4. Set attenuator and SWR meter range switch as listed below and verify that SWR meter indicates within limits shown.

SWR Meter Range (dB)		Attenuation (dB)			Meter Indication (dB)					
					Minimum		Actual		Maximum	
8494A&B	8495A&B 8496A&B	8494A&B	8495A&B	8496A&B	8494A&B	8495A&B 8496A&B	8494A&B	8495A&B 8496A&B	8494A&B	8495A&B 8496A&B
10	2	0	0	0			Set to 0.0	Set to 0.5		
10	6	1	10	10	0.40	1.40	—	—	0.60	1.60
10	12	2	20	20	0.90	0.30	—	—	1.10	0.70
10	16	3	30	30	1.35	1.25	—	—	1.65	1.75
10*	22	4	40	40	1.85	0.15	—	—	2.15	0.85
12	26	5	50	50	0.35	1.10	—	—	0.65	1.90
12	32	6	60	60	0.85	0.00	—	—	1.15	1.00
12	36*	7	70	70	1.30	0.90	—	—	1.70	2.10
12*	42*	8	—	80	1.80	-0.15	—	—	2.20	1.15
14	46*	9	—	90	0.30	0.75	—	—	0.70	2.25
14	52*	10	—	100	0.80	-0.30	—	—	1.20	1.30
14	56*	11	—	110	1.75	0.60	—	—	1.75	2.40

\*Adjust range by 2 dB, if needed, to obtain an on-scale indication.

**Figure 1. Operator's Check**

## Replacing the Connector Outer Shell

### NOTE

*The connector outer shell can be replaced only on the Option 001 (Type N female) or the Option 003 (APC-7). The outer shell on the Option 002 (SMA) cannot be replaced in the field.*

The connector outer shells on the Option '001 and 003 may be replaced as follows:

- a. With a 9/16-inch (1/2-inch for APC-7) thin open-end wrench, unscrew the outer connector body.
- b. Replace the connector outer shell. See Table 3 for replaceable parts numbers.
- c. Tighten the connector with the same wrench called out in step a.

**Table 3. Replaceable Parts**

HP Part Number	Description
0370-1091	Knob
1250-0907	Option 003 APC-7 Center Conductor Contact
1250-0909	Option 003 APC-7 Connector Outer Shell Assembly
1250-0914	Option 001 Type N Female Connector Outer Shell
2220-0006	Screws for both bases: 4-40 x 7/8 in. Fillister head
7120-0543	Label 0-110 dB for 8496A & B
7120-3376	Label 0-70 dB for 8495A & B
7120-4525	Label 0-11 dB for 8494A & B
08495-20021	Base for 8495A & B
08496-20008	Base for 8494A & B and 8496A & B

**NOTE**

*Option 002 (SMA) connectors are not replaceable without access to the interior of the instrument. If these connectors are damaged, return the instrument to Hewlett-Packard.*

## MANUAL CHANGES

This section contains information for adapting this manual to older instruments. If your instrument's serial number prefix is not listed on page 2 of this manual, and the serial number prefix on the instrument is 2543A or lower, you may document your instrument by following the instructions below. If your instrument has a serial number prefix higher than is listed in this manual, it may be documented in a separate MANUAL CHANGES supplement.

- a. In Table 1, Specifications, change the ATTEN UATION REPEATABILITY to  $\pm 0.03$  dB, typical after 1 million cycles.
- b. In Table 1, Specifications, change the MINI MUM LIFE to >1 million steps or switchings per section.
- c. On the WARRANTY page, change the war rantied period from two years to one year.

If you have an older instrument, one with a serial number prefix of 2543A or lower, you must make the following changes to this manual in order for this manual to apply to your instrument.

## CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

## WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of two years from the date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error-free.

### LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

### EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

## ASSISTANCE

*Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.*

## HEWLETT-PACKARD SERVICE OFFICES

To obtain servicing information, contact the nearest Hewlett-Packard Sales and Service Office in HP Catalog, or contact the nearest regional office listed below.

### UNITED STATES

NO. CALIFORNIA (San Francisco Area)  
333 Logue Ave.  
Mt. View, CA 94043

SO. CALIFORNIA (Los Angeles Area)  
Instrument Repair Center  
1421 S. Manhattan Ave.  
Fullerton, CA 92631

GEORGIA  
450 Interstate N. Parkway  
Atlanta, GA 30348

ILLINOIS  
5201 Tollview Dr.  
Rolling Meadows, IL 60008

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